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ENERGY $AVER$

"For Business and Industry"

VOLUME 4/NUMBER 4

SHIELDING YOUR ENERGY COSTS WITH INSULATED WALLS AND ROOFS

The Facts...

Installing a non-conductive material in your walls, attics and roofs will not only make your building more comfortable, it will significantly help to contain your energy costs.

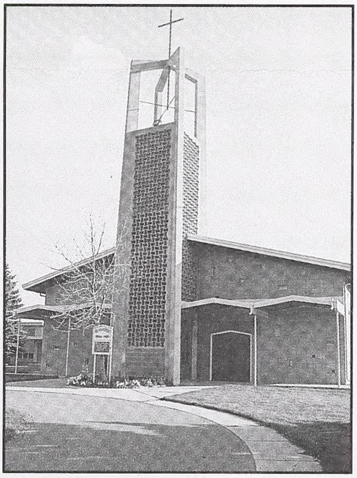
Within a building, heat is transferred three ways — by conduction, convection and radiation. Bulk or mass insulation is designed to retard conductive and convective heat loss while reflective materials reduce radiant heat flow.

Bulk insulation such as fibreglass batting, cellulose fibre or rigid sheets of foamed plastic or polystyrene (open-cell insulation) have tiny air spaces which break up the heat-flow path. R-values (or metric RSI numbers) are a measure of a product's resistance to overall heat transfer. The greater the density of the insulation, the higher the R-value.

With conduction, heat can move through the exterior membrane of a building by passing from molecule to molecule. Generally, the denser the material — where the molecules are closer together — the more quickly heat can move. Concrete, for example, is a better heat conductor than wood which is less dense.

Within a building, air currents move across the ceiling and down the walls. With little or no insulation, significant amounts of heat will be lost to these areas. A more common mode of convective heat transfer occurs when wind-driven cold air enters a building through openings in the structure or when warm air escapes to the outside in a similar way.

Convection currents only form when air has enough room to move. If trapped in small spaces or cavities less than half an inch wide, air becomes a good insulator, helping to prevent the transfer of heat.



St. Ambrose Catholic Church in Coaldale, constructed of non-insulated concrete blocks.

Improper installation of insulation in exterior walls will allow convective air currents to form which may increase the overall transmission of heat in the wall assembly.

Infrared radiation also conveys heat. Through radiation, heat can pass from warm objects to cool objects without warming the air in between. Although reflective insulation is available, heat transfer through this method is generally not a major concern.

Insulation for the commercial sector is available in a number of forms including:

- blanket or batt (e.g. spun glass fibres)
- rigid boards (e.g. expanded polystyrene, extruded polystyrene, glass fibre boards, polyurethane and polyisocyanurate)
- blown-in fibres or foam (e.g. cellulose, glass, polyurethane, mineral or rock wool)

When choosing an insulation product, building owners should consider the product's R-value, the cost of materials and installation, ease of installation and the availability of the product. Each type of insulation has a different R-value per inch. For instance, fibreglass batts are rated at R-3.5 per inch; extruded polystyrene, R-5 per inch; polyiosocyanurate sheathing, R-7 per inch; and rigid glass fibre board, R-4.25 per inch.

The church's interior walls (showing concrete blocks) prior to renovations.

Increasing insulation and R-values of walls and roofs will significantly reduce both heating and cooling costs in a building. Since buildings operate as a system, the characteristics of each building (e.g. window surface area or type of mechanical systems) will govern how much energy is saved by increasing the R-value.

When insulating attics, care must be taken to ensure insulation is kept away from soffits and gable end vents. Lack of adequate ventilation can lead to condensation problems.

Building owners should keep in mind that upgrading insulation levels in existing walls and flat roofs just to save energy usually results in longer payback periods. This is primarily due to the difficulty in gaining access to these areas. However, when necessary renovations are being done, it can be an attractive opportunity to upgrade to higher R-values at the same time.

The Application...

Following a visit from Alberta's Energy Bus in December 1988, board members of St. Ambrose Catholic Church in Coaldale decided to save energy and, at the same time, make their church and office area more comfortable for parishioners.

As suggested by the energy audit team, church members arranged to have the interior of their church walls insulated.

Built in 1960 with eight-inch non-insulated concrete blocks, the church occupies about 3,760 square feet (349 square metres) of floor area.

Prior to the renovations, the church was cold in winter and hot in summer, says Father Bryan Frank, a former priest at St. Ambrose. "On very cold days, there was frost on the inside of the walls. In the summer, the walls were so hot, you couldn't touch them," he says.

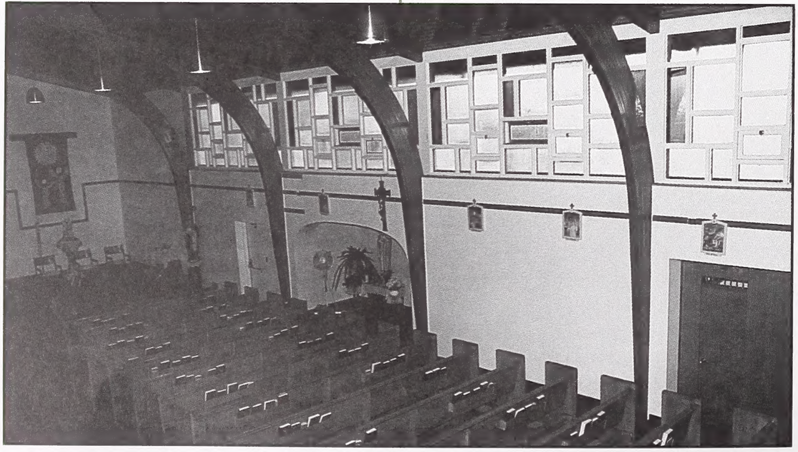
Instead of the 68 degrees F (20 degrees C) now maintained in the church during winter, the thermostat had to be cranked up to 80 degrees F (27 degrees C) during the heating season.

Renovation of the walls in the church and office area, completed in October 1989, raised the R-value of the walls to about R-12. Since then, the church's annual natural gas bills have been reduced by about 30 per cent despite the extremely cold winter experienced in Alberta in 1989.

During construction, a local contractor used two by four framing, 32 bundles of three-and-a-half inch fibreglass batting and drywall. The total cost of material and labour amounted to about $5540.

The church is now saving about $850 per year on natural gas expenses. A major portion of these savings can be attributed to the renovation of the interior walls. To calculate the payback period on the investment in insulating the walls, capital costs are divided by net savings: $5540/$850 = 6.5 years.

The renovation project has not only saved parishioners energy and money, it has enhanced the attractiveness of the church's interior and greatly improved comfort.



The church's interior walls after insulation and drywall were added.

The Bottom Line...

In general, increasing the R-values of walls and roofs is most cost effective when done in conjunction with renovations, repairs or a new construction project. Insulating for the sole purpose of saving energy usually results in less attractive payback periods.

Building owners, however, should examine the economics for their facility to see if payback periods are attractive. For instance, cost effective opportunities do exist to insulate a building shell strictly for saving energy. A good example is a poorly insulated attic where fibreglass batts or cellulose fibre can easily be installed over the existing insulation.

Upgrading insulation during a renovation project such as roof replacement or repair may not always prove cost effective. Building owners should get an estimate of their energy cost savings before proceeding with a project.

The example of St. Ambrose Catholic Church in Coaldale shows that insulating a building skin can be a worthwhile measure when done for the purpose of making the building more comfortable and attractive.

As a guideline to determining the magnitude of annual savings that can result from an insulation project, building managers can use the accompanying graph (Figure 1) and calculation described below:

The graph shows the annual natural gas costs for an area of 10,000 square feet (930 square metres) and a range of R-values. To use Figure 1, you must determine the R-value of your existing insulation and the R-value of your walls or roof after adding insulation.

The green lines on the graph show the annual energy costs for R-5 and R-40 insulation for the example calculation below.

FIG. 1

Natural Gas Cost per Year
10,000 square feet (930m^2) wall/roof area

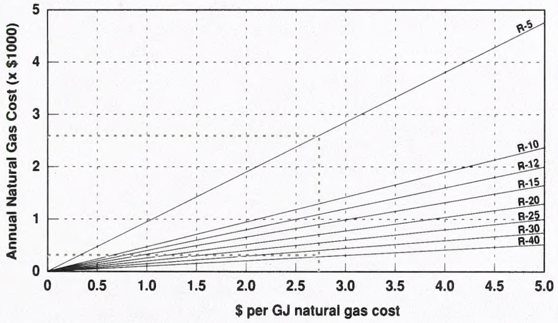
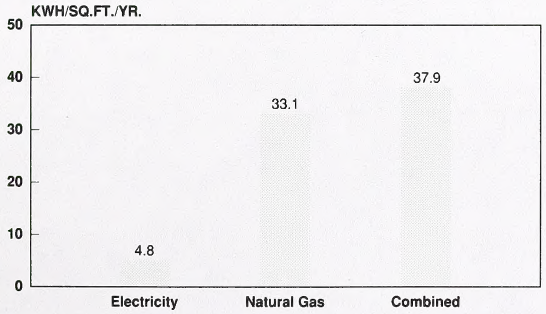


FIG. 2

ENERGY USE — CHURCHES



(Multiply by 10.76 to covert to KWH/m^2/YR)

EXAMPLE: Improve roof insulation by laying fibreglass batts on top of existing insulation in attic space.

Existing Insulation: R-5 (RSI .88).

Proposed Insulation Upgrade: R-40 (RSI 7).

Insulation to be used: fibreglass batt R-3.5 per inch.

Natural Gas Cost: $2.75 per GJ.

Roof Area: 3000 square feet (279 square metres).

Cost of conversion: $1350.

Annual energy cost for R-5 insulation

= $2600

Annual energy cost for R-40 insulation

= $325

Annual savings equals the difference between the two

annual costs: = $2600 - $325 = $2275

Annual savings for 3000 square feet:

(Figure 1 is based on 10,000 square feet)

3000/10,000 x $2275 = $682.50

Simple payback:

Divide the cost of conversion by the yearly savings:

$1350/$682.50 = 2 years.

SECTOR REVIEW

Energy audits conducted by staff of Alberta's Energy Bus program throughout the province have shown that energy use varies widely, depending on the type of building and the activities in the building.

An energy audit determines how much energy is being used and how much it costs in each area. Efficiency measures are then identified which may result in energy cost savings.

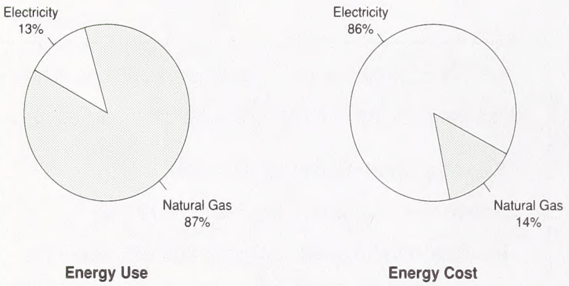
Based on 49 audits of churches, the Energy Bus team has identified potential energy savings of about 19 per cent in this sector.

Figure 2 shows energy use for churches. In this analysis, annual energy use (based on building floor area) is indicated for natural gas, electricity, and combined electricity and natural gas.

Figure 3 compares energy use and cost. In Alberta, natural gas is the least expensive form of energy. For the audited churches, the average price of a unit of electrical energy is about six times that of an equivalent unit of natural gas.

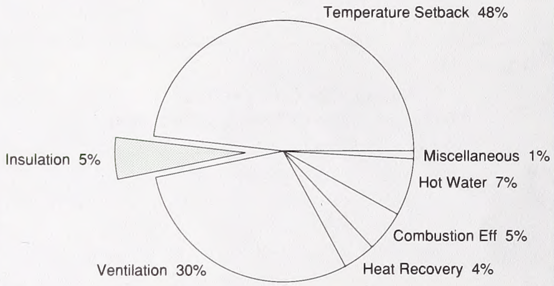
Energy Bus audits have identified many opportunities where insulating building shells would lead to significant savings. The addition of insulation represents about five per cent of the total natural gas savings potential in this sector as shown in Figure 4.

FIGURE 3 Churches Energy Use and Cost



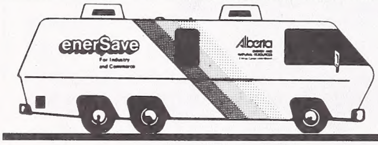
Energy Use **Energy Cost**

FIGURE 4 Potential Natural Gas Savings



FOR MORE INFORMATION

The article *Shielding Your Energy Costs With Insulated Walls and Roofs* was researched and written by David Supruniuk and Carol Miyagawa. The Energy Efficiency Branch gratefully acknowledges editorial reviews done by Bob Rymell and Mike Baudais, Fiberglas Canada Limited; Sean Coghlan, Dow Chemical Canada Limited; Bruce Rupert, Beaver Lumber Home Centre; Ken Manning, Can-Cell Industries Incorporated; and Father Fred Sogs, Pat Morton and Dianne Knight, St. Ambrose Church.



ENERGY $AVER$

Energy $aver$ is a series of fact sheets about energy efficiency measures that have wide application in Alberta. Each issue highlights a different technology and its successful use in the province. The Sector Review summarizes energy use patterns of different facilities that have used Alberta's Energy Bus audit service. Comments, questions and suggestions are welcome.

Write or phone (collect) to be placed on the mailing list. You may also receive back issues or arrange for an Energy Bus audit (conducted at no charge).

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